(P00NM-010US)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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In re patent application of
Shojiro MIYAKE et al.
Serial No. 09/545,181 Group Art Unit: 1775
Filed: April 7, 2000 Examiner: A. Turner
For: SLIDABLY MOVABLE MEMBER AND METHOD OF PRODUCING SAME

DECLARATION UNDER 37 CFR § 1.132

The Commissioner of Patents
and Trademarks
Washington, D.C. 20231

Sirs:

I, Yoshiteru Yasuda, a citizen of Japan, hereby declares and states as follows:

(1) I received my Master of Engineering degree in Precision Engineering from Osaka University, Osaka, Japan in 1986, and have been hired by Nissan Motor Co., Ltd.

(2) In my work for Nissan, I have been involved since 1986 in the study of metallic materials, surface treatment and tribologist at Materials Research Laboratory in Nissan Research Center.

(3) I am a co-inventor of the subject matter claimed in U.S. Patent Application serial No. 09/545,181. I have reviewed an Office Action for the application, mailed June 19, 2002, and the prior art cited therein.

(4) I have conducted or directly supervised the following experiments:

Specimen Preparation 1:

First, a disc-shaped substrate 2 made of carburized steel (SCM415, chromium molybdenum steel, according to JIS G 4105) was prepared to have a dimension of a 30 mm diameter and a 4 mm thickness, as shown in Fig. 1 of U.S. Patent Application serial No. 09/545,181. A super finishing was made on the upper surface of the substrate 2 to have a surface roughness Ra of 0.04 μm. Thereafter, a hard carbon-based film (diamond like carbon coating) 3 was coated on the upper surface of the substrate 2 by an ion plating process, as shown in Fig. 1. The above procedures were repeated upon varying the condition of the ion plating process so as to obtain three specimens.

Specimen Preparation 2:

First, a disc-shaped substrate 2 made of carburized steel (SCM415, chromium molybdenum steel, according to JIS G 4105) was prepared to have a dimension of a 30 mm diameter and a 4 mm thickness, as shown in Fig. 1 of U.S. Patent Application serial No. 09/545,181. A super finishing was made on the upper surface of the substrate 2 to have a surface roughness Ra of 0.04 μm. Thereafter, a hard carbon-based film (diamond like carbon coating) 3 was coated on the upper surface of the substrate 2 by a chemical vapor deposition (or plasma CVD) process, as shown in Fig. 1. The above procedures were repeated upon varying the condition of the chemical vapor deposition process so as to obtain three specimens.

Measurement of Hydrogen Content:

The content of hydrogen in the hard carbon-based film was measured by SIMS (Secondary Ion Mass Spectroscopy) in which a diamond like carbon film was used as a standard. The three specimens obtained by Specimen Preparation 1 showed respectively measured values V1, V2 and V3 plotted in Fig. A attached herewith. The three specimens obtained by Specimen

Preparation 2 showed respectively measured values V4, V5 and V6 plotted in Fig. A .

Measurement of Friction Coefficient:

Each specimen obtained by the above specimen preparations was subjected to measurement of friction coefficient μ by using a pin-on-disc type friction tester 41 as shown in Fig. 3 of U.S. Patent Application serial No. 09/545,181, in which the friction coefficient μ of the diamond like carbon coating was measured in the lubricating oil under conditions in which the load applied to the three balls 44 was 1 kgf; and the relative sliding velocity was 0.03 m/sec. The three specimens obtained by Specimen Preparation 1 showed respectively measured values V1, V2 and V3 plotted in Fig. A. The three specimens obtained by Specimen Preparation 2 showed respectively measured values V4, V5 and V6 plotted in Fig. A .

Experimental Result:

As shown in Fig. A, the diamond like carbon coatings formed by the ion plating process showed their hydrogen contents which were nearly zero, which could realize a desirable low coefficient μ of not higher than 0.07. However, the diamond like carbon coatings formed by the chemical vapor deposition process shows their hydrogen contents higher than 10 at%, which could not realize the desirable low coefficient μ of not higher than 0.07.

(5) HFC-134a+PAG oil shown in the cited reference (U.S. Patent No. 5,843,571) is a compressor oil. HFC –134a means a coolant, and PAG means polyalkylene glycol (water-soluble synthetic base oil). Thus, the HFC-134a+PAG oil is a mixture of the coolant and the water-soluble synthetic base oil, and therefore is largely different from a lubricating oil for an internal combustion engine which lubrication oil is hydrophobic and contains the oiliness agent. An example of the ratio of the coolant and the water-soluble synthetic base oil in HFC-134a+PAG is 600 g : 160 g.

(6) I further declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent resulting therefrom.

Date: 09/27/2002

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FIG. A